Future Studies and Strategic Planning to Achieve Resilient Cities

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Abstract

Every year, crises cause extensive and occasionally irreversible damage to countries and human societies affecting communities, economies, and environments. Identifying, proper planning, and optimum managing of crises are among the priorities of government programs and procedures. With the expansion and complexity of the societies and variety and innumerability of crisis-making factors, mere use of traditional methods of reinforcement and crisis management would not be efficient. One of the most important ideas brought about in the present decade for crisis management and urban planning is creating resilient cities in the face of various crises by increasing their capacity in all aspects. The significance of this standpoint is the comprehensive look at crisis-making factors, controlling crises, and reduction of vulnerability, particularly in human resources, which speeds the resilience process. Although all infrastructural or environmental, economic, social-cultural, and organizational or institutional aspects have been taken into consideration in resilience, the focus on social and cultural capacitating in each and every citizen would be greatly effectual in a developing country such as Iran. This land endures weak infrastructures and structures, but enjoys a rich cultural and national support from the citizens' creativity and participation that can help us with achieving the goal of flexibility in crisis management by spending the least amount of time and money. In the present paper, the experiences of other nations and novel concepts such as creative cities, resistant development, principles of futures study and planning, and process-oriented strategic management have been studied along with the current state of Iran. Finally, the method of "Strategic Futures Study and Planning based on GIS" is suggested as a suitable approach in crisis management planning. In the author's point of view, complete use of this method could help us significantly reduce the losses of disasters and pioneer in the field of crisis management among developing countries.

Key words: futures study, resilience, flexibility, GIS, strategic planning, crisis management

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1. Introduction:

Cities are interconnected series of complex and compressed utilities with dense populations and resources. That is exactly why they are faced with a large number of factors that lead to and exacerbate hazards. Right now, more than half of the world's population is living in urban areas, which has made securing cities a long-term yet unapproachable challenge. As a dynamic living being, cities are driving forces behind national growth. Meanwhile, emergency incidents, disasters, and crises have threatened and disrupted people's lives throughout history, particularly in urban areas. Intense climate changes, earthquake, flood, storm, and other manmade threats pressure increasingly people and intimidate booming of cities. In such conditions, man has always tried to ensure his survival and peace of mind by winning over crises in various ways. As crises have become numerous and more complex with advances in human sciences and achieving new technologies in time, methods of controlling and dealing with them have improved and their effectiveness increased as well. What was significantly considered in traditional methods of dealing with disasters, was improving the body and physical structure of the city only, while overlooking the fact that bearing capacity of residents and their reactions to crises are among the most important aspects of increasing urban resistance against disasters. It so happens that occurrence of an incident blows out of proportion by confusion and chaos among people, and turn into a catastrophe. Therefore, social aspects have also been center of attention in the new approach of crisis management. Borbi (2001) has described (traditional) reduction of hazard risk as "people-free policy". David Godschalk (2003), University of North Carolina, is one of the people who talks about the necessity to factor citizens in crisis management along with the rest of the parameters in an article on resilient cities, and requests respective campaigns aiming at reassuring the security of urban cultures in 21st century. This trend eventually led to formation of an international resilience campaign (HFA, Hyogo Framework for Action) in 2005 in order to reinforce societies and nations against disasters. Focusing on the technological role of GIS and other relevant technologies is of high importance in the new approach to crisis management.

2. Mental Framework and Principles:

2.1. Futures Study or Future Research:

Futures study includes all efforts that depict potential futures and prepare plans for them by analyzing resources, patterns, and factors of stability or instability. Future study reflects how the reality of future is born in the heart of today's changes. The plural word "futures" is employed in the phrase in order to systematically and sensibly assume "several prospective futures" rather than simply "one possible future" using a vast range of methodologies. Futures study subjects include states of "probability", "possibility", and "desirability" when crossing present towards future. Futures study by no means equals prophecy; however, it aims at anticipating the positive and negative events, attempting to reach ideal conditions, preserving stability in future, preventing adverse events, or minimizing the damages or losses. We need to plan, prepare, and act in such a way that will get us closer to our end. Evidently, that requires but the cycle of crisis management since creative planning to have societies resilient and flexible in the face of crises would practically be impossible without taking into consideration the various aspects of futures study. It can be said that the undesirable circumstances today and the numerous problems impeding our path is a result of inadequate consideration in the past for a future that has now arrived. Overall, there are two main anticipating approaches in futures study or futures creation.

2.2. Effective Factors on Determining Disaster Risk:

We need to understand that disasters are not natural. What transforms an incident or occurrence into a crisis depends on a variety of factors, most important of which include the level of individual preparedness and ability to deal with one, level of risks when disasters strike, and vulnerability percentage.

Risk or damage probability is a function of hazard and refers to a state where people and assets are exposed to hazards and conditions of vulnerability. These factors are not static and can be improved depending on the institutional or individual capacities to reduce risk. Incorrect social and environmental patterns can increase "exposure to risk" and "vulnerability", leading to an unwanted increasing risk. How various factors interact and affect determining the possibility of a risk turning into a catastrophe is mentioned below in the form of an equation.

(Source: How to Make Cities More Resilient, a Handbook for Local Government Leaders, 2012)

Therefore, it can be said that risk is affected by hazard, level of vulnerability, and exposure to hazards directly and by flexibility or capacity to deal reversely.

2.3. Vulnerability:

Vulnerability of a system is a function of two parameters: exposure to hazard, and sensitivity. Exposure means who or what is endangered by risks, and sensitivity of a system refers to a level at which humans and places are harmed (Cutter et al, 2008). Vulnerability is a direct product of interaction between natural environment and artificial environment meaning systems or human societies.

2.4. Disaster Risk Reduction:

Futures study of disaster risk reduction through systematic measures to analyze and manage casual factors of disasters includes reducing exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment , and improved preparedness to cope with adverse events. Risk reduction also includes actions that are taken in order to decrease or eliminate risks which people and assets are exposed to (guided by the global policies set out in the Hyogo Framework for Action 2005-2015). Risk reduction is a step of crisis management which breaks the circle of damage, reconstruction, and damage again (FEMA, 2000). Risk reduction consists of a vast range of measures, from civil engineering rules and regulations to planning land use and ownership in the form of detailed plans.

2.5. Disaster risk management:

Disaster risk management is the systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities to lessen the adverse impacts of hazards and the possibility of disaster. It aims to avoid, lessen or transfer the adverse effects of hazards through activities and measures for prevention, mitigation and preparedness (UNISDR).

2.6. Definition and Aspects of the Word "Resilient":

This word has been used for various definitions such as "resiliency", "transformability", "bouncing back", and "flexibility". This term was first brought about and developed in mechanic physics during the recent century. This science classifies substances into two general groups of flexible and rigid. A resilient substance enjoys flexibility to absorb and depreciate force as well as proper resistance against forces, so it bounces back after removing the force. Rigid substances are on the other end of the bar, and break suddenly when under pressure or forced upon in spite of looking highly firm and resistant. Flexibility and resilience were introduced in 1960s by ecologists and then psychologists. Psychologists compared the concept of resilience with risk study and described it as coping with problems and adverse events by responding flexibly to pressures of everyday life.

In 2000s, the use of this concept was first introduced

in "risk reduction in disasters". Similarly to human beings or a substance, a resilient society is one that is able to stand the aftermaths of a disaster and prevent a certain amount of damage as well as reduce the deadliness and intensity of a disaster through flexibility and compatibility towards hazards, one that would finally bounce back to normal conditions before the event in the least amount of time. The term "resilience" is often used as "bouncing back to the way things were" derived from the Latin root of "Resilio" meaning "to jump back" (Kelin et al, 2003).

In 2005, United Nations International Strategy for Disaster Reduction (UNISDR) also defined resilience as an endangered system's or society's capability to resist, absorb, cover, and bounce back efficiently when faced with effects of a crisis which includes maintenance and mending of basic structures and functions.

2.7. History and concept of GIS:

Technology of GIS originated more than 30 years ago in the business world, but its widespread use goes back to the recent few years only. Geographic information system is in fact a system which has been created to receive, store, combine, process, analyze and exhibit the data that locally have been referenced to earth. This system normally consists of a reference computer base and software in keeping with its practice.

3. The Resilient and Flexible City:

It can be concluded that a resilient city is in fact a resistant network of skeletal systems and human societies where skeletal systems including the natural and artificial environments of the city count as a human body and the society as the soul and mentality within. In the face of crisis, problems, and difficulties, mankind's resistance and bouncing back to the ideal state is conditioned by health, resilience, and flexibility in both aspects of body and soul. Thus, in a resilient city not only does the body (the public and private buildings), vital arteries, and even its natural and geographical features need to be resilient whether on their own or together, but the social community (all temporary and permanent) residents also must behave and continue to act resiliently whether in an organized manner of private and public institutes or as individuals. Resilient cities are built in urban areas based on the rules collected from the experiences of past incidents. They may bend against the force of hazards, but will never break down (David Godschalk, 2003).

Resilience (flexibility) is not limited to one single method. It is applicable in different cities of difference regions around the world under unlike circumstances at times of crises and disasters. This feature indicates the role of creativity in planning resilient cities in addition to depicting the possibility of vastly utilizing this method of crisis management, which is dependent on expansive, up-to-date, and varied information which is easy to save and manage in geographical systems.

4. Global and International Attention towards Resilient Cities:

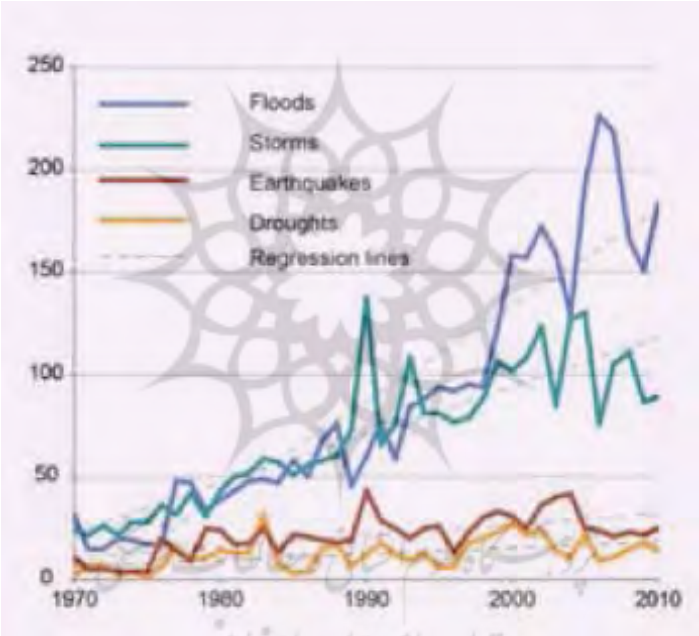
After suggesting the framework of action to make nations resilient titled "Hyogo Framework for Action 2005-2015" in the risk reduction conference in Hyogo, Japan, and receiving approvals from other member countries in 2005, this matter has moved up to the highest priority of societies that are dealing with crises and trying to optimally control and manage them.

Since then, HFA has tried to guide national policies of countries and international organizations in a way that would significantly reduce the damage and loss stemming from natural hazards. In addition to addressing the roles of states, regional and international organizations, this comprehensive framework calls on civil society, academia, volunteer organizations, and the private sector join efforts as well. This framework has declared a ten-year period - from 2005 to 2015 - for local governments, and municipalities in particular to plan, take action, and achieve the global goals. In all aspects of the expected measures by Hyogo's campaign such as identifying the potential risks, risk reduction, raising public awareness and preparedness, studied in attached table 1, dependency on location data and its correct interpretation is

clearly visible.

5. Global Evaluation of Crises and Adverse Events:

Figure 1, shows recorded disaster events worldwide and indicates an increasing trend as well as number of actual occurrences. The figure indicates that the number of recorded seismic events (deadliest in terms of loss of life) is relatively constant, but points to an increase in the reported number of storms and floods. In many parts of the world, the risks associated with weather-related hazards are on the rise (the risk of economic losses is also on the rise, although fewer deaths have been recorded). The number and intensity of floods, droughts, landslides, and heat waves can have a major impact on urban systems and resilience strategies. Depending on the location, climate change is likely to increase the frequency of precipitation in many regions. This will imply changes in flood patterns and contribute to upward trends in coastal high water levels. These extremes need to be factored into future land-use plans and other measures, according to the IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. The increase in impact will remain largely dependent on human activity in terms of exposure and vulnerability.



.Figure 1: Number of recorded disasters
Source: EMDAT-CRED, Brussels

6. City Risk Factors:

Some of the most general factors of risks in crises identified in various cities around the world (according to the handbook published by ISDR) have been stated in table 1.

Number	Factors of increasing disaster risks among cities
	Growing urban populations and increased density, which put pressure on land and services, increasing
1	.Settlements in coastal lowlands, along unstable slopes and in hazard-prone areas
2	Concentration of resources and capacities at national level, with a lack of fiscal and human resources and capacities in .local government, including unclear mandates for disaster risk reduction and response
3	.Weak local governance and insufficient participation by local stakeholders in planning and urban management
4	Inadequate water resource management, drainage systems and solid waste management, causing health emergencies, .floods and landslides

5	The decline of ecosystems, due to human activities such as road construction, pollution, wetland reclamation and unsustainable resource extraction, that threatens the ability to provide essential services such as flood regulation and protec-.tion
6	?Decaying infrastructure and unsafe building stocks, which may lead to collapsed structures
7	.Uncoordinated emergency services, which decreases the capacity for swift response and preparedness
8	Adverse effects of climate change that will likely increase or decrease extreme temperatures and precipitation, depending on localized conditions, with an impact on the frequency, intensity and location of floods and other climate-related .disasters

Table1. Stimuli for disaster risks in urban areas by ISDR

Aside from the issued mentioned in the table above, many other crisis-making factors can be named for Iran, most important of which are drought, landslides, and earthquakes. Earthquakes have become the most significant crisis-making factor in Iran due to three main reasons: they are unpredictable, Iran has an individual geographical situation in the continental collision zone – almost the whole country is situated on the universal seismic belt, and the infrastructures and textures are weak and rusty – which brings along heavy casualties. Therefore, the strategic plans of resilience against natural disasters in Iran will be affected accordingly, where failure to have a unified urban management counts as a great challenge by itself.

7. Aspects of Resilience:

Resilience is a large and comprehensive concept that chases a grand goal. As we mentioned earlier, resistance against natural disasters in the past could merely be seen in securing buildings, infrastructures, and vital arteries in order to resist a certain amount of disasters. In addition to environmental respects, other significant ones including social, cultural, and economic aspects are primarily effectual on resilience. At times, dealing with a disaster and mending its physical damages take a relatively short while, whereas its negative effects on the society and economy last for years to come, causing a challenge for the process of resilience or bouncing back. That is why planning for crisis management based on resilience with a comprehensive approach must include special attention towards social, cultural, and economic resilience too, that includes education, public awareness, skill, networks and connections, participation of all classes of people and public and private sectors, local understanding of the hazard, providing necessary resources to cope with a disaster before, during, and after it, identifying the institutional contexts and interactions, awareness on reinforcements and skeletal issues, resistance, and variety in employment and economy. Based on the aforementioned and conducted studies, suggested aspects to consider for procedures of resilience and assessment indicators are reviewed in table 2.

Number	Aspects of Resilience	Description
1	Social-cultural	Enhancing the capacity to cope with, deal with, and react properly to an incident, self-assistance, sticking to values which is achievable through education and culture, flexibility in society and spiritual and mental support by citizens to improve conditions and return to stable ones.
2	Economic	People's inner reactions and compatibility in case of threats so that it would enable them to reduce potential economic losses (Rose, 2005). In other words, it refers to the ability to have economic resilience and bring back employment for local residents.
3	Organizational and institutional	This includes factors responding to risk reduction, planning, and use of previous experiences, and covers institutional areas and social organizations. Resilience means society's capacity to reduce risk, increase activity, and also participation of locals to reduce risks to create organizational bonds and improve and maintain social systems in a society (Norris et al, 2008).

4	Infrastructural or environmental	It includes resilience in vital arteries of the city (water pipe networks, sewage system, electricity and connections), persistence and capacity of rescue teams and medical centers, structural resistance, properly indicating uses of open spaces and shelters, or limited heights of buildings, which basically provides the physical resilience for a city.

(Table2. Various aspects, sides, and areas of procedures for resilience and determining indicators of assessment (source: M. R. Rezayi, 2001, Authors

8. Strategy and Strategic planning:

Strategy is a comprehensive, collective plan, which combines all the advantages and positive strategic points in an organization or any company with other environmental factors, changes and challenges. And it's designed in such a way to ensure the achievement of all goals of the company. This type of planning is usually done on a senior management level, including devising the main duties of the organization, providing facilities to achieve the goals of the organization and determining operational output based on number of years.

9. Various types of strategies in analysis of SWOT:

According to the analysis of SWOT, four types of strategies are obtained based on analysis, confluences and similarities of strengths, weaknesses, opportunities and threats; which can be cited as Table 3.

Quantitative and qualitative goals 1. … 2. … 3. …	Strengths S1 … S2 … S3 …	Weaknesses W1 … W2 … W3 …
Opportunities O1 … O2 … O3 …	**Aggressive strategies** Those which have been established based on the application of strengths to implement the opportunities.	Gradual change strategies Those that have been established based on the removal of the weaknesses to implement the opportunities
Threats T1 … T2 … T3 …	**Continuous improvement strategies** Those that have been established based on application of strengths to fight the threats.	Defensive strategies Those that have been established based on removal of the weaknesses to fight the threats.
Urban GIS areas: (data, application systems and services, information technology, business)		

Table3. Model of the extraction of SWOT analysis strategies based on the information from the recognition stage

10. Strategic Urban Planning via Resilience Approach:

Although separate planning for resilience and improving flexibility of a city is feasible, reaching a maximum of efficiency depends on a total coordination between this program and metropolitan development plans. As a result, it would be a great opportunity to think of a plan based on resilience and flexibility if a city already lacks development plans. However, if the city enjoys one, it would be time to look it over and reexamine the aspects to correct and complete it within the frameworks of resilience principles so it would include all risk reduction factors. Process of strategic planning for a city must be collaborative and provide the chance for urban management and beneficiaries to adopt the best method of coordination based on the ten-principle programs for urban development plans and actions. In addition to providing proper knowledge on resources and potential human, cultural, social, economic, technological, ecological, and natural capacities, strategic planning enables local societies to also identify weaknesses, vulnerabilities, and key priorities for risk reduction and get concentrated on them. So, the city can embark on simultaneous assessment and analysis of internal and external factors knowing its own strengths and weaknesses, opportunities, and threats during the planning process (a Handbook for Local Government Leaders, 2012). The essential measures in various phases of strategic urban planning are mentioned in table 4.

Phases	Milestone Phases	Steps
Phase One	Organizing and preparing to apply the Ten Essentials	1.Prepare institutional setting, raise awareness
		2. Convene actors, formalize participatory process
		3. Plan and execute the process
Phase Two	Diagnosis and assessment of the city's risk	4. Be acquainted with the city's risks
		5. Conduct a risk assessment
		6. Analyze the local environment and actors
		7. Prepare an assessment report
Phase Three	Developing a safe and resilient city action plan	8. Define vision, objectives and main actions
		9. Define programmers' and projects
		10. Institutionalize and sustain the disaster risk reduction plan
Phase Four	Implementing the plan	11. Implementation and resource mobilization
		12. Ensure broad participation and ownership
Phase Five	Monitoring and follow-up	13. Monitor, follow up and evaluate the plan
		14. Disseminate and promote the plan

Table4. Essential measures in various phases of strategic urban planning of a resilient city

11. Futures Study and Strategic Planning for Resilient Cities:

The emerging of science of strategic management in 1960s was contemporaneous with genesis of novel and scientific methods and techniques of anticipation in form o futures study, because organizations had realized they needed to be equipped with long-term and efficient strategies in the competitive environments surrounding them, and how the traditional methods and means of anticipation cannot accommodate the dynamic and complex future any longer. That is why ever since, futures study and strategic management have advanced along each other in scientific and academic environments (A. Aalizade, 2009). Considering the complexities of urban areas on the one hand, and daily increasing variety of crisis on the other, utilizing strategic planning based on futures study in sustainable development of urban areas, particularly in dealing with crises with a resil-

ience-based approach, can lead to profound changes in this regard.

12. The Role of Strategic Thinking in Planning Resilient Cities:

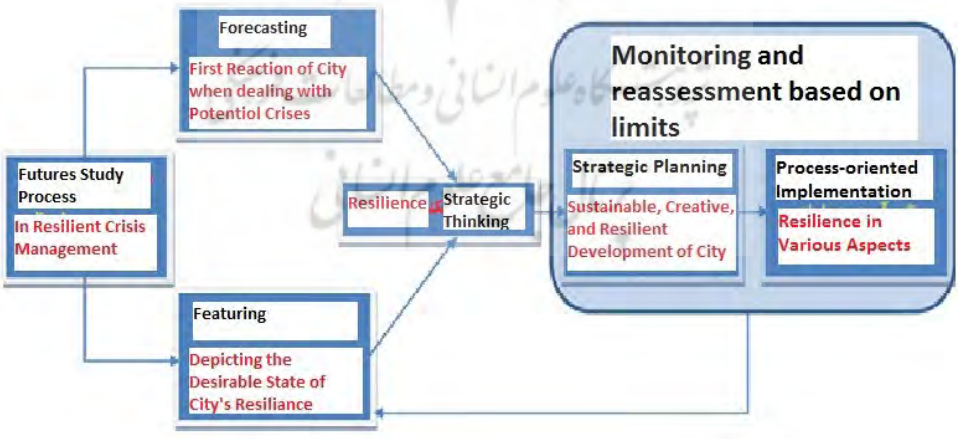
Strategic thinking has a long-term approach towards issues and (in addition to improving conditions) tends to differentiate between organizations and their opponents, which requires a competitive advantage. Strategic thinking guarantees a future according to the principles and organization's needs, and while insisting on pioneering is not limited to the predefined patterns (A. Aalizade, 2009). Thus, it can be said that strategic thinking based on novel ideas and methods and consistent upon a desirable future makes up the foundation of strategic planning for sustainable and resilient development of cities.

13. Futures Study of Strategic Planning for Resilience in Cities when Coping with Crises

Most events and occurrences are predictable and conscious and targeted interference by humans will result in desirable and ideal conditions in their formation process. As previously mentioned, future studies consist of two aspects of forecasting and featuring. In forecasting method, an image of future is obtained through precise evaluation of current conditions from the viewpoints of facilities, strength and weakness and opportunities and threats, which may be desirable or disastrous. On the contrary to this process, in featuring, first utopian and ideal conditions are relived and accordingly, facilities, required potential and necessary acts are programmed and operated in order to its provision and for obtaining this idealism identification. In featuring process and strategic programming of flexibility of cities, both anticipation attitudes on the basis of current situation and featuring in accordance with ideals are considered.

In image 2, the diagram of future studies process in crisis management with flexibility point of view is illustrated.

As you can see, in this model, first current situation of city is evaluated on the basis of correct information in forecasting process and upcoming challenges in face of Crises are identified, in the following through featuring process, desired and unexaggerated targets of city Resiliency are codified. Execution of these two phases facilitates the establishment of strategic thinking of considered city resiliency.



(Figure 2- the diagram of strategic future studies process in crisis management, with viewpoint of resiliency (source: Authors

In the following, according to strategic thinking formation of city resiliency, strategic programming process of city sustainable development is performed, relying on innovations and wisdom. Here, monitoring process and program evaluation are executed based on varied limitations of time, finance, allocable resources, existing capacities and …, and if it was necessary, considered targets become more lim-

ited and adjusted by going back to featuring stage and the model will be performed once again. Ultimately, after necessary modifications, program enters implementation phase, which of course monitoring and improvement and modification processes are continued in this phase.

14. Information role in featuring strategic programming of resiliency of cities:

Access to information and valid and up-to-date local data in particular plays a decisive role in different procedures of crisis management. Bearing in mind that more than 80% of the required information in crises has a local nature, using modern technologies of GIS is crucial to the process of data management of crisis managements. while keeping in mind the numerous effective factors and provocation in strike of a crisis and its impacts and results, it can also be stated that by analyzing the layers of data throughout both procedures, before and after the crisis; geographic information system with special capabilities in modeling and data analysis can help the authorities and managers toward the proper decisions and actions.

Number	Informational Layer	Usage in crisis management
1	Concentration and division of the population	Detecting the dangerous spots that inflict heavy casualties
2	The rescue squad centers	A sought-after plan for development and distribution of centers before striking of disasters and optimum management and proper guidance of performing teams.
3	Medical centers	A proper plan for facilitating and developing before the strike of a crisis and optimum management of transferring the injured and providing medical service during a crisis.
4	Routes and passages	Professional guidance of performing teams through a crisis, bearing in mind cases such as the width of the passages, access, and… predictions and modifications of routes in hazardous regions.
5	Mosques and governmental departments	As backup and service centers, providing the volunteers.
6	Greenfield sites	For temporary camps or rescue squads' serving spots
7	Geological zone scheming (such as geological information, pedology, and underground waters and…)	Modeling and analyzing the natural conditions of the earth in order to help the programming and proper crisis management to reduce its unfavorable impacts.
8	Seismic zone scheme	Verifying the perilous locations and avoiding constructions of dangerous industrial centers (such as chemical material factories) in these regions by remaining in the appropriate distance for residential centers or crowded structures and also programming the proper retrofitting of the structures
9	Determining the limits and categorizing different structures such as historical constructions,…	Programming a plan to modify the texture, access, retrofitting
10	Main arteries data (Water and sewage system, electricity grid,…)	Predicting the incidents and accident-prone spots, performing preventive actions in order to have the minimal damage and maximal service at the strike of a crisis.
11	Health GIS	In order to predict and model the crises of hygiene and health and epidemic diseases, and have a plan to prevent and properly confront the situation, proper distribution of services in keeping with the aforementioned cases.

Table5. A selection of the origin locations and their role in optimum crisis management

15. GIS position in the featuring proposed model of strategic programming of resiliency of cities:

In different sections, featuring strategic programming of resiliency is in need of clearly evident and specific information and basically this model is of spatial nature and encompasses a broad range of place dependent information. In forecasting phase, analysis of primary behavior of city is considered in occurrence of possible crises for existing situation. It is obvious that this analysis requires extensive information such as mentioned items in the schedule below. Which considering the effects of these entire data and the result of their interaction are not possible to conquer without using a strong organizer such as GIS. This is GIS which can provide us with possibility of different kinds of analysis and achieving possible scenarios through precise and correct definition of required descriptive information layers. Also in featuring phase, which the purpose for planning of actions is to reach desired future, it is necessary to consider changes and indicators improvement in different zones and review their effects in improvement of results. Existence of GIS in this process also leads into acceleration and facilitation of evaluations. Also In codification of fourfold strategy of strategic planning, points of weakness and strength, threats and opportunities won't be defined except on the basis of information on abilities, deficiencies and risks. Spatial information systems also play a key role, in implementation of process centered resiliency program in different dimensions of cities, monitoring and reviewing process development and discovering issues and performing program modifications.

16. GIS related technologies and their role in featuring strategic planning of cities resiliency

16.1. Decision supporting system or DDS:

This system evaluates different information layers related to each issue through various analytic models and techniques. Spatial decisions supporting systems SDSS, provide the possibility of achieving proper solutions for crisis control via the help of geographical information systems and based on existing facilities and with a systematic viewpoint in the minimum amount of time. In featuring strategic planning of crises resiliency, in which there is no practical possibility for direct experiencing, SDSS system provides the possibility for simulation, forecasting and evaluation of proposed solutions in featuring via using proper models.

16.2. Spatial data basis, WEB GIS, disaster information network and DIN conceptual model:

Governments require information in order to control and manage crises. For this, it is necessary to provide planners and related managers with comprehensive, on time and appropriate information for each phase of crisis management circle, either in strategic planning phase or in time of crisis occurrence and until there's not a possibility for reaching these information there would not be a possibility for decision making or optimum planning. From the scientific view point, the discussion of spatial data information (SDI) and web based spatial information system and their application in crisis management for establishment of disaster information network, is a new discussion in the world. Establishment of networks such as DISASTER INFORMATION NETWORK or in abbreviation DIN network based on GIS is one of the appropriate methods for providing this information. A practical conceptual model of DIN, in department of spatial data management should be designed in a way that in time of crisis occurrence, factors which are present in crisis scene can transmit information related to most recent situation of region to crisis room, in crisis room there are separated places for restoring information related to each organization and an operator who is in charge of entering information related to each organization, controls the authenticity of spatial information, sent from place of attachment, considering the basic information available and saves them in data source in case of Logical adaptation verification For displaying occurred events, it suffices for the previously presented plan to be refreshed, in order for entered information to

be applied in system. In this case, users with access to internet and having a web explorer, can view the latest existing situation crisis. Importance of organizations interactions in provision and verification of information through models and frameworks of spatial data Infrastructure (SDI) and web based systems, specially WEB GIS, is not limited to time of crisis and is also of importance in forecasting and featuring phase, which of course lack of united urban management in Iran is one of the important challenges of achieving this matter. On the other hand, via defining access levels in WEB GIS and publication of general articles about the crises, we'll be able to attempt to train citizens and make culture for them which are of the pillars in establishment of flexible cities.

16.3. Gathering and updating information systems:

a) Spatial and geographical information systems based on cell phones:

These systems are capable of being used in determination of geographical zone faced with crisis and proceedings guidance based on spatial-geographical coordinates for management crisis via Propagation of waves and radio signal and GPS, also some programs can be made as practical Programming languages in cell phones in form of specific programming algorithms, which can be used in a fast, automatic and intelligent manner in evaluation of the area of operation in geographical zone faced with crisis. Determination of estimation and crisis management aspects requires using GIS technology, which is well developed and can include sections of crisis estimation, control analysis and also choosing, using and evaluating section.

b) Remote Assessment and Satellite Imaging

With satellite technology appearing and obtaining earth information from space, a new horizon has been widened in the field of required spatial information provision for planning and dealing with crises and the increasing growth and development of making hardware and producing computer software in matter of processing and analyzing space and satellite information, has enabled the possibility of gathering and analyzing information in quickest way possible. Nowadays we can attempt to do things in different aspects such as inserting satellite images as backgrounds of GIS plans in order to create better understanding in experts, rapid updating of information, identification of crisis centers like faults or even material identification of earth layers or discovering unknowns in underground through using advanced technology of lidar and radar. All of these points assist us in establishment of an integrated information structure based on GIS which is required for forecasting, evaluation, modeling and featuring of strategic planning of cities resiliency, faced with unexpected events. And of course in real scene, crises occurrence is also a guarantee for proper crisis management and achieving flexibility targets.

19.1. GIS and Principles Checklist of Global Campaign for Resilience:

The Hyogo Framework for Action 2005-2015 has formulated a 10-fold principle book for cities to achieve resilience against disasters, and offers it to urban managements around the world. Preciseness in each principle and required foundations to implement them indicates a tight connection among them and geographical information system. In the table below, these 10 rules and their importance on the path to the goals of GIS-based resilience are explained.

Principle	Description	Necessity	Connection with GIS
1.Provision of Discipline and Coordination	Create unity among respective organizations. Make sure that all organizations and sectors know their roles in connection with risk reduction and preparation for crises.	All classes, groups, organizations, institutes, and even academia must be examined and granted qualification. To facilitate this, creating coordination and education and encouragement among people to participate, and a responsible organization's forecasting is essential.	Data layer of organizations and active NGOs at times of crises to inform people to participate, evaluate, and create proper distribution in community, and showing support and unity.
4.Budget Assignment	Assign a particular budget to reduce risk for homeowners, minimum-wage families, various social groups, companies and public sector in order to be encouraged to invest and participate in the risk reduction process.	Evidently, if you fail to provide the required budget, planning to achieve resilience will remain a mere plan with no chance of implementation.	Data layers of rusty and problematic contexts, also distribution of families around the city based on income to have proper evaluation and budget assignment, and assess the results of conducted plans.
3.Assessment of Multiple Risks	Exact and up-to-date data on risks and hazards must be collected, classified, restored, and analyzed, and keep them as a basis for all urban plans and decisions. Conveniently provide people with this data and make sure people are aware of it around the city.	If cities are not well aware of their potential risks and hazards, effective planning and risk reduction will not be possible. Analyzing risks is a prerequisite to preparing for risk reduction measures, determining the priorities in projects, and identifying risks in various regions based on their vulnerability. An up-to-date databank and proper use of GIS-based systems to access plans of hazard zonation, vulnerability, and exposed capacities are considered the basis for risk assessment.	Most of the crisis management data depends on geography, thus, risk assessment requires environment and information. A GIS context prepares a suitable environment to update and use the information systematically and be assessed simultaneously from various aspects. On the other hand, WEB GIS provides citizens, active groups, and experts with proper access regarding dealing with crises.
4.Maintenance and Upgrading Infrastructures	Invest in vital foundations such as surface water collection facilities that help reduce risks and maintain them while adapting them to climate changes if necessary.	Roads, bridges, airports, electricity, sewage and water systems, phone companies, hospitals, and emergency services, and energy sources are crucial at a crisis. Disorders in the aforementioned could lead to more damage and greater incidents.	Maintaining and developing vital arteries is not feasible without knowledge on geology (faults, slopes, earth material, and …), population, traffic, considering the simultaneous effects of all factors, and also monitoring current conditions. This will be realized in defining proper GIS data layers and overlaying them.

5.Maintaining the vital, hygienic, medical, and educational facilities	Assess the safety of schools and hospitals and renew and secure them if necessary.	Schools and hospitals are not only home to the most vulnerable classes of people, but they are also centers for care, development, and welfare, and offer necessary social services. These centers are of importance even after crises as shelters to the injured. They must open as fast as possible to prevent mental and social disorders and ease children's pain.	Assessing proper distribution of these centers around the city for citizens' quick access, proper reinforcement management, and optimum use of medical, rescue, and educational centers are all among geographical data, whose best analysis is done in GIS-based systems.
6.Construction Regulations and Efficient Land use planning	Put in practice construction regulations, and realistic building and land use bylaws precisely. Identify less hazardous lands that can be assigned to less wealthy families. Secure and reinforce unofficial residences as much as possible.	Setting rules and regulations, and implementing secure construction bylaws along with proper land use to keep citizens away from hazardous areas, and proper distribution of rescue teams and centers, and open spaces are crucial in risk reduction, and are more economical than insecure reinforcements.	Editing exact regulations according to the physical necessities of each city, proper distribution of open spaces to shelter the injured at crises, proper land use away from hazardous areas, and controlling suburban residence all depend on geographical data. Using results of projects such as analysis of flood risks or seismic zonation of cities require GIS capacities as well.
7.Education and Culture (official-public)	Schedule educational programs on risk reduction in schools and local gatherings and raise public awareness.	All social classes must be aware of the risks they are exposed to so they can pay attention to warnings. Therefore, education, information, and creating capacity to take risks and measures to reduce disasters seem like the key to have people participate in risk reduction activities.	Management and planning for public education and identifying crisis-prone regions, and description of previous disasters for citizens can be done more efficiently and effectively in WEB GIS.
8.Protecting the environment and enhancing ecosystems	Protect ecosystems and natural zones that act as a wall to prevent great damages from floods and storms (which may harm your city). Adapt your risk reduction with climate changes, by utilizing correct methods.	Developing cities often change the environment around them and create new risks. Maintaining a balance between human activities and nature seems to be a primary solution to reduce risk and help city's resilience.	Certainly planning for sustainable development with the least amount of damage to the environment and far from hazardous regions requires comprehensive geographical data and its analysis.
9.Effective preparedness and quick reactions	Create early warning systems and crisis management capacities in your city and continue to have regular crisis drills for with people's participation.	The secret to sustainability is keeping citizens and authorities informed of the importance of preparedness and dealing with crises. Proper planning for preparation and coping with crises will save people and property as well as reducing risks and helping with resilience afterwards.	Planning, management, implementation, and directing preparation drills according to the potential scenarios of crises is a complicated process that needs GIS-based crisis management data.

9.Rehabilitation and restoring the society	After each crisis, make sure that the needs of the injured and survivors are met by the help of people and their representatives, and restoration and rehabilitation is ongoing. Moreover, citizens must be supported in planning and conducting those plans of restoring houses and jobs.	Cities are built within decades and centuries, therefore, restoring a city in a short amount of time is a daunting task. There is a mutuality between needs and quick and secure restoration. A restoring plan that is well thought through and collaborative can contribute to the commencement and speed of restoring the activities of a city in the least amount of time possible.	Managing the distribution of basic needs, directing rescue teams, proper locating of supply centers, and post-crisis distribution requires sufficient knowledge on the physical state of the city. Planning resistant restoration and returning ownerships to survivors are among requirements of crisis management, all of which can be feasible through data layers of GIS.

Table7. The 10-fold principle checklist to make cities resilient

17. Conclusion:

As is clear in Chengdu Declaration of Action in August, 2011, there is no such thing as a "natural disaster". Natural occurrences such as flood, earthquakes, landslides, and storms turn into disasters due to vulnerability in various areas including infrastructural, economic, and social. They can be dealt with through policies, strategies, and measures and participation of local beneficiaries. Risk reduction with a resilient approach is a remorse-free investment that protects lives, assets, and jobs. In this novel perspective, the most important role of resilience in case of a crisis in urban areas has been given to social and human factors since with resilience in societies and individual capacities of each citizen, the process of bouncing back to the state before the crisis and even improvement can be speeded up. This theory completes mere reinforcement are of high significance in developing countries such as Iran with complex issues including weak infrastructures and structures and expansive rusty contexts, which take a long time and huge amounts of money to mend and restore. It is in fact a shortcut to risk and damage reduction, and reinforcing structures that is dependent on people's participation. The resilience process is actually a motion towards sustainable urban development, improving creativity, and encouraging people's participation to achieve a creative city and feature a secure and stable society in form of a strategic plan. In that regard, what is most important would be provision of up-to-date and precise data. Required data for crisis management, whether physical or social and economic, depends on geographical information. Therefore, GIS and its component features can provide a decent context for featuring strategic planning of resilience for a city with its remarkable capabilities in restoring and analysis of information, modeling, monitoring, and scenario writing. In addition to contributing to long-term planning of reinforcement of infrastructures and structures, this method helps access goals of resilient cities to reduce casualties quickly through investing on citizens and societies in a developing country such as Iran.

18. References:

1- Compiling GIS strategy of Isfahan Municipality," Analysis of Municipal GIS in the metropolis of Isfahan." Second Edition, GIS management and mechanized system of Isfahan Municipality.

2- Compiling GIS strategy of Isfahan Municipality, "compiling GIS strategic municipal planning for the metropolitan city of Isfahan", Fourth Edition GIS management and mechanized system of Isfahan Municipality.

3- Compiling GIS strategy of Isfahan Municipality, "Conceptual modeling of municipal GIS for the metropolis of Isfahan", third edition, GIS management and mechanized system of Isfahan municipality.

4- Zarabi, Asghar & Khayambashi, Ehsan, the 5th GiT4NDM Conference, Future Studies and Strategic Planning to Achieve Resilient Cities, Canada, 2013.

5- Khayambashi, Ehsan, the 4th GiT4NDM Conference, Application strategic planning in the creation and development of GIS crisis management, Toyland, 2010.
6- Khayambashi, Ehsan & Mosavi, Pedram, Meisami, Hossein,Ahmad Rafiaei, Rajabi, Gholamreza, Montazerolghaem, Hamid, Passive Defence,2010
7- How to Make Cities More Resilient, a Handbook for Local Government Leaders, 2012.
8- Philip Berkea and Gavin Smit , Hazard Mitigation, Planning, and Disaster Resiliency: Challenges and Strategic Choices for the 21st Century, In Sustainable Development and Disaster Resiliency, Ed.Urban Fra: Amersterdam, The Netherlands: IOS Press (2009)
9- Bosher, L, Dainty, A, Carrillo, P, Glass, J and Price, A (2007) towards a protocol for built-in resilience to disasters. In: Boyd, D (Ed) Procs 23rd Annual ARCOM Conference, 3-5 September 2007, Belfast, UK, Association of Researchers in Construction Management, 831-840
10- David R. Godschalk, Urban Hazard Mitigation: Creating Resilient Cities, NATURAL HAZARDS REVIEW © ASCE / AUGUST 2003
11- LAWRENCE J. VALE ,THOMAS J. CAMPANELLA, Editors,The Resilient City: How Modern Cities Recover from Disaster, Published by Oxford University Press, Inc(2005)
12- A contribution to the Global Campaign 2010-2015, Making Cities Resilient – My City is Getting Ready! , How To Make Cities More Resilient, A Handbook For Local Government Leaders, Geneva, United Nations International Strategy for Disaster Reduction, March 2012
13- International Strategy for Disaster Reduction, A practical guide to Local Self-Assessment of Progress in Disaster Risk Reduction, HFA, 2011 – 2013
14- Making Cities Resilient Report 2012, A global snapshot of how local governments reduce disaster risk, UNISDR
15- HFA, PROGRESS in Asia-pacific, Regional Synthesis Report, 2009-2011
16- UNISDR,Towards a Post-2015 Framework for Disaster Risk Reduction, 16 February 2012
17- the World Bank, the United Nations International Strategy for Disaster Reduction, and the World Meteorological Organization ,The Role of Hydro meteorological Services in Disaster Risk Management, Washington, D.C. – March 12, 2012
18- United Nations International Strategy for Disaster Reduction Regional Office for Africa ,Toolkit for National Platforms for Disaster Risk Reduction in Africa, September 2010
19- God schalk, David, Edward Kaiser, and Philip Berke 1998. Integrating hazard mitigation and land use planning. Pp. 85-118. Burby, Raymond, Ed. In Cooperating with nature: Confronting natural hazards with land-use planning for sustainable communities. Washington, D.C.: Joseph Henry Press.
20- TCPA Regional Planning Task Team, Strategic and Regional Planning, January 2003.
21- Maleky Amjad, Zoning the risk of earthquakes and the priorities in improved housing in Kordestan Province, Geographical research Magazine , no. 59, spring 2007
22- Valizadeh kamran, Software in Crisis mgt. based on GIS
23- Daneshju Farhad, Basics of Earthquake Engineering and Risk analysis 2008
24- Charles Landry, Franco Bianchini,The creative city, First published in 1995 by Demos Reprinted in 1997 and 1998 by Demos.
25- "SWOT Analysis, A short introduction", European Community Civil Protection Mechanism
26- FEMA 2001, Concept paper for section 322 of the Stafford Act as Amended by the Disaster Mitigation Act 2000.
27- Sasaki Masayuki,The Role of Culture in Urban Regeneration, Diàlegs - Fòrum Universal de les Cultures – Barcelona 2004.
28- UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION, Foresight Methodologies, 2004.
29- Prepared for the City of Toronto by AuthentiCity, Creative City Planning Framework, February 2008
30- www.unisdr.org/campaign
31- http://resilientSF.org
32- http://www.memarinews.com
33- http://resilientSF.org
34- www.charleslandry.com, The Creative City Index
35- http://strategic.blogfa.com/post-117.aspx